--18. (New) Excipient for powder for filling hard capsules, comprising pulverulent mannitol as produced in claim 13.--

REMARKS

By this amendment, claims 1 to 9 have been withdrawn from examination without prejudice and have been replaced with new claims 10-18. Claim, 10 to 18 are pending.

REJECTIONS UNDER 35 U.S.C. 112

Claims 1 and 3 were rejected under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Reconsideration is requested in view of the amendment in claims 1 and 3.

The explanation of Test A and Test B have been respectively introduced in new claims 10 and 12. Support for these amendments are to be found at page 5, lines 13-15 and at page 7, lines 7-14.

These passages of the description fully enable the person skilled in the art to carry out the Test B by specifying material and methods.

As for Test A, it only relates to a basic measurement of the packed density which is used in the everyday work of the skilled person in the field of powdered sugars. The measurement of the packed density belongs to the basic knowledge of the person skilled in the art since it is a means of characterizing the products. The Applicant has specified on which apparatus the packed density is to be measured by concern for scientific rigor, but it would be

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superfluous to include the operating instructions of an apparatus in the claims, especially of an apparatus which is well-known in the field.

In addition and for information, the Applicant herewith provides the operating instructions of the HOSOKAWA P.T.N. powder tester at the time of the invention. This provides evidence of the knowledge of the person skilled in the art.

In view of the above, it is respectfully submitted that the rejections under 35 U.S.C. 112, should be withdrawn.

REJECTIONS UNDER 35 U.S.C. 102

Claims 1 to 9 were rejected under 35 U.S.C. 102(b) as being anticipated by US patent 5,573,777 to Serpelloni et al..

Reconsideration is requested for the reasons that follow:

The object of claim 10 is a pulverulent mannitol having:

- an average diameter of between 60 and 200 μm, preferably of between 80 and 180 μm; **and**
- a packed density, determined according to the method specified in the operating instructions for the HOSOKAWA P.T.N powder tester, **of between 0.65 and 0.85 g/ml; and**
- a flow factor of at least 60, preferably of between 60 and 90.

The combination of these unique physical characteristics renders the pulverulent mannitol of the invention particularly suitable for use as filling agent for small hard capsules in pharmacology.

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The Examiner asserts that the pulverulent mannitol of Serpelloni et al. anticipates all limitations on the product of the invention.

The Applicant respectfully disagrees with this assertion.

Serpelloni et al. disclose a pulverulent mannitol obtained by an atomization stage and then a granulation stage of said atomized mannitol (see col. 8, lines 32-38).

The resulting pulverulent mannitol has a low apparent density comprised between about 0.300 g/ml and about 0.525 g/ml (see col. 5, lines 65-66: 300 g/l and 525 g/l).

This pulverulent mannitol has also a low packed density as it is emphasized in the comparative Table V of the present invention.

Table V at page 15 of the instant specification sets forth the comparison between the physical characteristics of the product of the invention with regard to the products of the prior art. The product of Serpelloni et al. is illustrated in column 5 entitled "*products obtained by atomization*" and exhibits a low packed density value of less than 0.6 g/ml.

On the contrary, the pulverulent mannitol of the invention has a high packed density value which is of from 0.65 g/ml to 0.85 g/ml. The pulverulent mannitol of the invention is hence novel over the product of Serpelloni et al..

As for claim 4, the process disclosed in Serpelloni et al. requires an atomization step and does not comprise a maturing step.

In view of the above, it is respectfully submitted that the rejections under 35 U.S.C. 102, should be withdrawn.

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REJECTIONS UNDER 35 U.S.C. 103

Claims 1-9 were rejected under 35 U.S.C. 103(a) as being unpatentable over US patent 5,573,777 to Serpelloni et al..

Reconsideration is requested for the reasons that follow:

The problem that the invention proposes to solve is to provide a pulverulent mannitol which is particularly suitable for use as filling agent for small hard capsules in pharmacology.

In practice, it is very important that certain physical properties of the pulverulent mannitol concur to render it suitable for use in hard capsules in the pharmacology field. This is particularly difficult since the physical characteristics of the pulverulent mannitol depend on each other. For example, if a specific physical property such as an average diameter is required, one cannot just process the powder so as to have this diameter without taking great care of the other characteristics because the average diameter has an influence on the flow rate, and on the density !

It is hence important to remember that it is this **whole combination** which allows to achieve the product of the invention.

While trying to solve this problem, the Applicant has surprisingly discovered a pulverulent mannitol having the following specific characteristics:

- an average diameter of between 60 and 200 μm, preferably of between 80 and 180 μm; **and**
- a packed density **of between 0.65 and 0.85 g/ml; and**
- a flow factor of at least 60, preferably of between 60 and 90;

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This pulverulent mannitol is particularly appropriate for use as filling agent for small hard capsules in pharmacology.

Serpelloni et al. show that for an average diameter of between 100 and 200 μm, with a flow factor of 70-90, the density is relatively low, i.e. of from 0.3 to 0.6 (see col. 11, column headed "*products in accordance with the invention*", entry "*Apparent density*").

The Applicant has also compared the packed density of the product of Serpelloni et al. to the packed density of the product of the invention. This is presented in Table V at page 15. The product manufactured by Serpelloni et al. has a packed density which remains **under 0.6** (see table V, page 15, column 5, line 3). Such low packed density renders the product unsuitable for use in hard capsules.

Thus, starting from Serpelloni et al. the person skilled in the art would learn that a product having such average diameter and such flow factor has a **low density which is unsuitable for the specific purpose of the invention**. The teaching of Serpelloni et al. is hence not useful for a person skilled in the art who tries to solve the technical problem.

Further, Serpelloni et al. do not provide any teaching to obtain a product with a high packed density. On the contrary, it is clear from Serpelloni et al. that a product with such average diameter and flow grade has a low density.

As for the process, Serpelloni et al. teach an atomization step which is not required by the instant invention. As a matter of fact, the process disclosed by Serpelloni et al. does not allow to manufacture the product of the invention and is hence not useful for the person who tries to solve the technical problem.

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In view of the above, it is respectfully submitted that the rejections under 35 U.S.C. 103, should be withdrawn.

*

* *

In view of the above, it is considered that the application is now in proper form for allowance.

Favorable consideration and prompt allowance of these claims are respectfully requested.

Respectfully submitted.

11-7-01

Date

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Reg. No. 28,297

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Attachments: - substitute claims,
- operating instructions.

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POWDER CHARACTERISTICS TESTER

OPERATING INSTRUCTIONS

HOSOKAWA IRON WORKS, LTD.
OSAKA, JAPAN.

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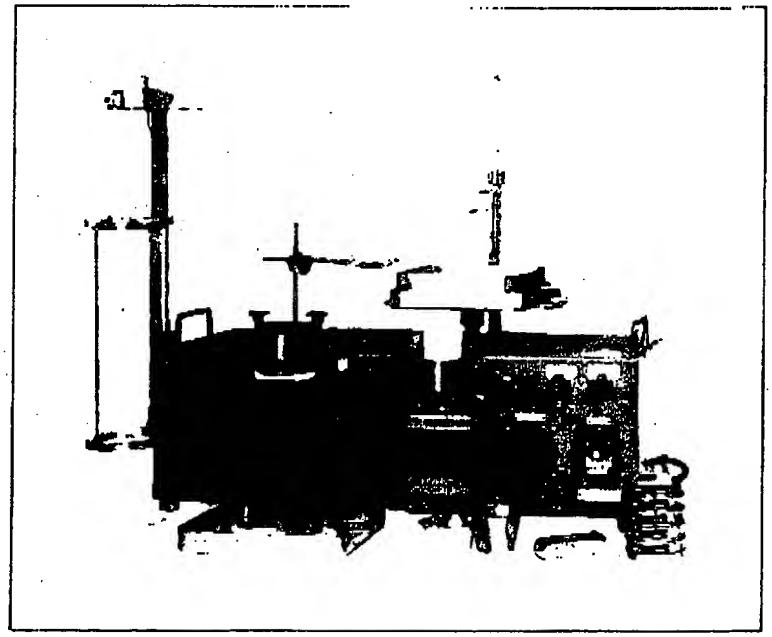
1. INTRODUCTION

The Hosokawa Micromeritics Laboratory has designed the Powder T ster based upon research performed and published by Mr. Ralph L. Carr, Jr., Chief Chemist of B I F, a Unit of General Signal Corporation, Providence, Rhode Island, U.S.A. Recognizing that the work of Mr. Carr was of great importance in the field of powder processing and handling the Hosokawa Micromeritics Laboratory designed the Powder Tester as a rapid aid to the chemist, chemical engineer or technologist dealing with powders for quickly arriving at the "flowability index" for any powder; thus providing the design engineer with a maximum of useful information for designing the most efficient powder handling equipment.

The Powder Tester has been designed to do mechanically many of the routines previously done manually. While it is recognized that experience will permit a trained person to arrive at comparatively constant results in performing certain manual operations there are many human factors that can produce misleading results. Such things as nervous tension, impatience, fatigue, a common cold and many other human ailments can be the cause of inaccuracy in performing a manual procedure. With the Powder Tester the human factors mentioned are eliminated. The unit is designed to perform in the same manner without variation the various procedures set forth by Mr. Carr. By controlled mechanical means a more consistent and accurate "flowability index" can be determined than by manual methods.

Few, if any, liberties have been taken with Mr. Carr's research except that the various measurements done by Mr. Carr have been converted to the metric system. Certain information contained herein has been used with the permission of Mr. Carr, and the copyright owner, McGraw-Hill Inc., New York, N.Y. 100036, U.S.A. It is recommended that the original works of Mr. Carr, published in the McGraw-Hill "Chemical Engineering" magazine issue of Jan. 18, 1965, be studied carefully; its through study will help the operator master the simple use and technicalities of the Powder Tester. Being familiar with Mr. Carr's work will enable the operator to quickly arrive at the mathematical answers to the problems of Powder Flowability.



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2. UNPACKING THE CASE

When the case is unpacked, the following items should b contained therein:

1. Main machine (Please refer to the drawing, photo 1)
2. Spatula assembly (Photo 2)
3. Dispersibility mearsuring unit (Photo 3)
4. Attachments, 25 pcs. including Parts Box (Photo 4)
5. Operating Instruction booklet.

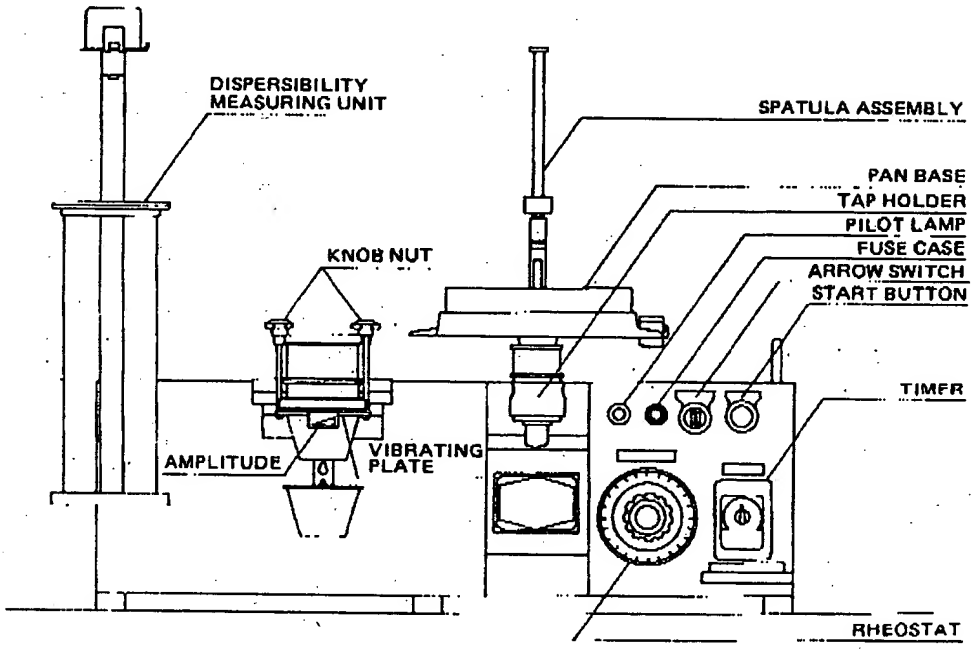


Photo 1

2) Spatula Assembly (Photo 2)

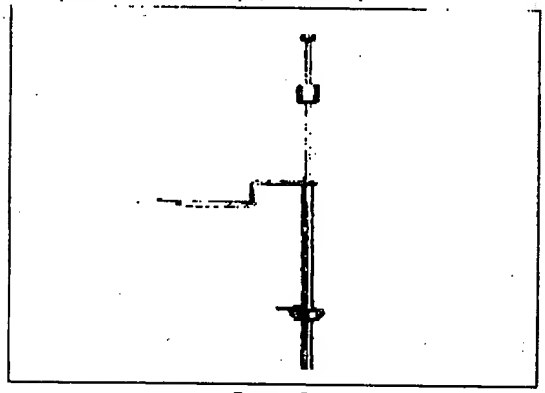
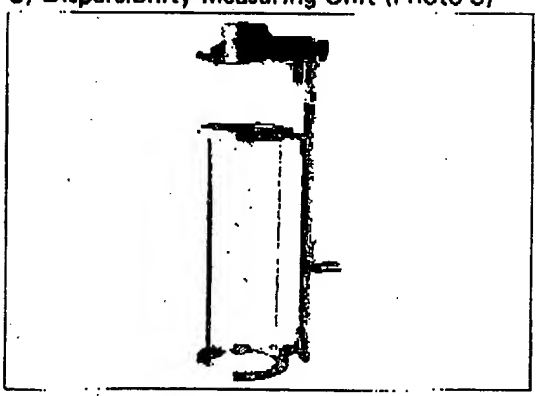


Photo 2

3) Dispersibility Measuring Unit (Photo 3)



Phot 3

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4) Attachments (25 pieces) (Photo 4)

① Square Pan

② Scoop

③ Scraper

④ Watch Glass (2 pcs.)
(1 pce. for spare)

⑤ Cup Extension Piece

⑥ Cup (for bulk density)

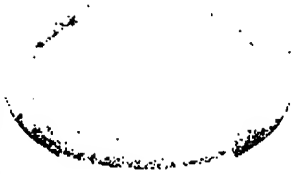
⑦ Guide (2 pcs.)
(1 pce. for spare)

⑧ Stationary Chute

⑨ Vibrating Chute

⑩ Screen
(#24, 40, 60,)
(100, 200,)
(350 1 each)

⑪ Screen Cover



⑫ Space Ring

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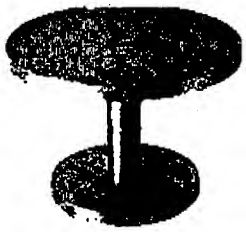
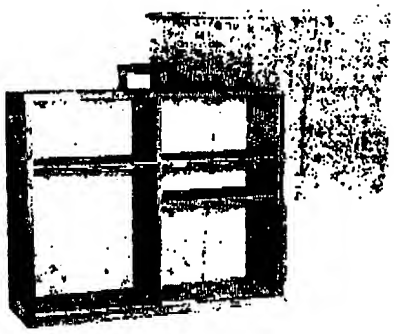
⑬ Screen Holding Bar

⑭ Pan



⑮ Protractor Stand

⑯ Platform



⑰ Shocker

⑱ Parts Box

Photo 4

3. PREPARATION FOR USE:

1. Place the Powder tester on a strong bench or work table. If possible, use a concrete or ceramic table. If the table is not rigid the vibration of the machine will result in non-stable data.
2. Insert the Spatula Assembly in the hole at the top of the main body so that the spatula points to the front of the machine. Please refer to Sketch 5. Ascertain that the positioning pin sets firmly into the hole of the Spatuls pole collar.
3. Place the square pan (1) on to main machine where the spatula is in place.

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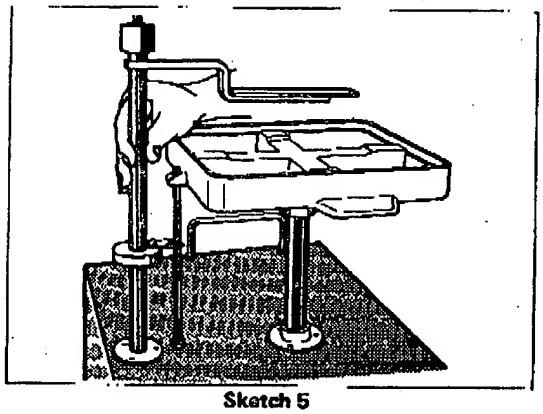
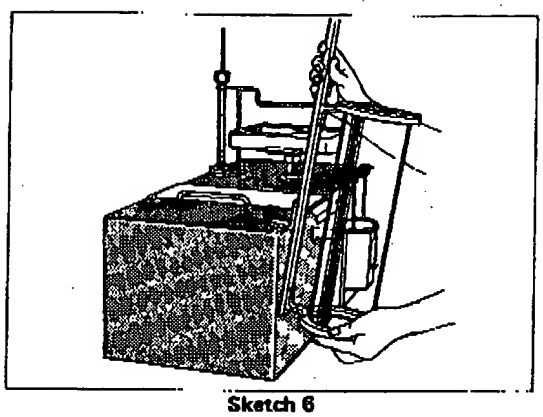


Sketch 5



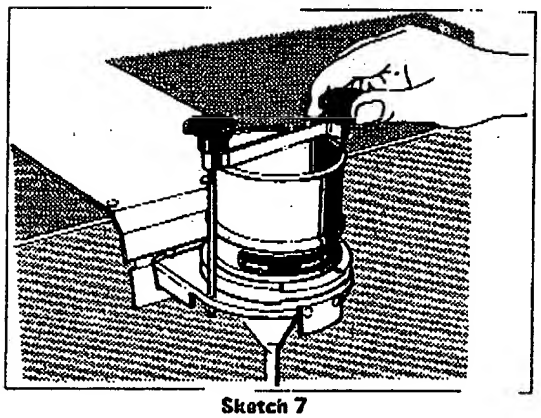
Sketch 6

4. Place the dispersibility measuring unit as shown in Sketch 6. (This unit may be placed for use only when required)
5. Connect the input power supply plug to the rated electricity outlet.
6. Insure that the pilot lamp is lit. If the lamp is not lit, check the fuse case, and replace fuse if necessary.
7. When preparation is completed the machine is ready for operation.

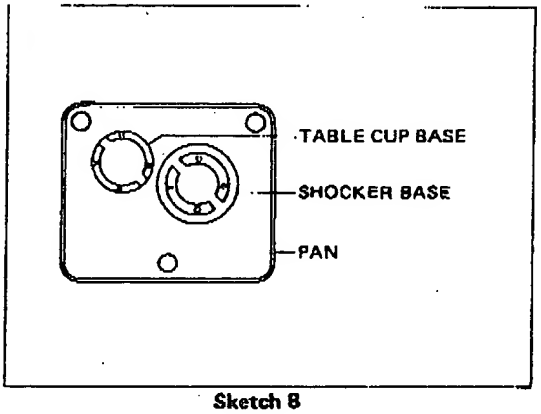
4. ANGLE OF REPOSE, ANGLE OF FALL AND ANGLE OF DIFFERENCE

4-1 Angle of Repose:

1. Remove funnel shapped guide (7) and the 24 mesh screen (10) from the vibrating unit holder, set the white plastic ring (12) on top of the glass funnel and then replace the 24 mesh screen and container. Place the screen holding bar and tighten the screw knobs. (Please refer to Sketch 7).
2. Place the round platform (16) in its base on the tray and carefully center under the glass funnel. (See Sketch 8).



Sketch 7



Sketch 8

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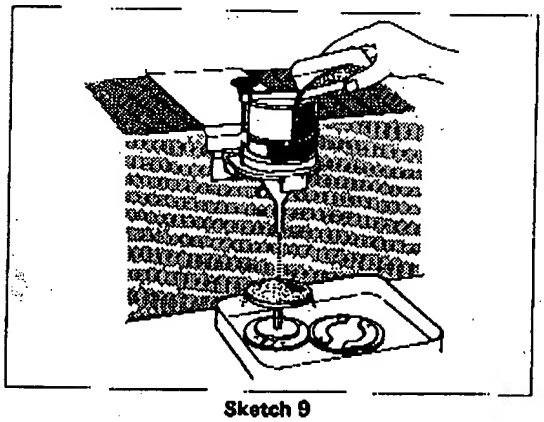
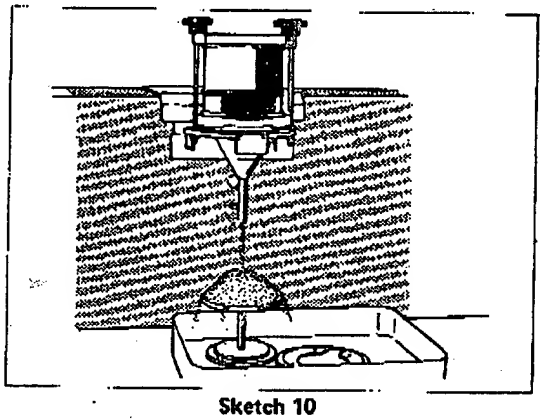
3. Using scoop (2), fill the container with the powder to be measured. Please refer to Sketch 9.



Sketch 9

4. Reset the arrow switch to "VIB" and set the timer switch to full length. (180 seconds on 60 cycle supply).
5. Ascertain that the rheostat is set at "0".
6. Push the "START" button.
7. Increase the voltage on the rheostat and let the powder flow out of the end of the glass funnel and build up on the round platform in a conical shape. Amplitude of vibrating plate should not exceed 2mm, as indicated on the vibration scale. The powder should be allowed to overflow the platform and on to the tray and when the round platform is completely covered with powder and a cone shape has built up the unit either may be stopped by returning the rheostat to "0" or the unit will stop automatically when the timer switch reaches the "0" position. Please refer to Sketch 10.



Sketch 10

NOTE: After the initial vibration is set it may be necessary to reduce the vibration amplitude in the event the powder is flowing too fast to build up to a cone shape. Vibration amplitude may be reduced by simply turning the rheostat back towards the "0" position.

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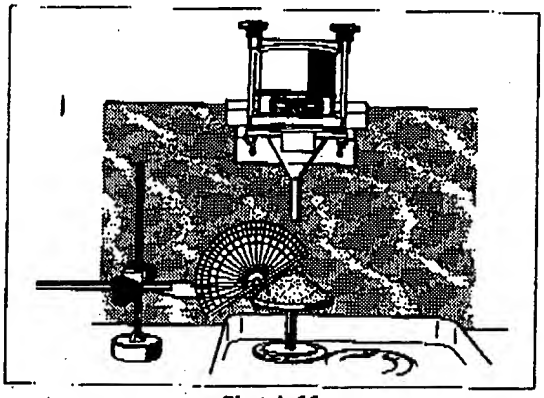
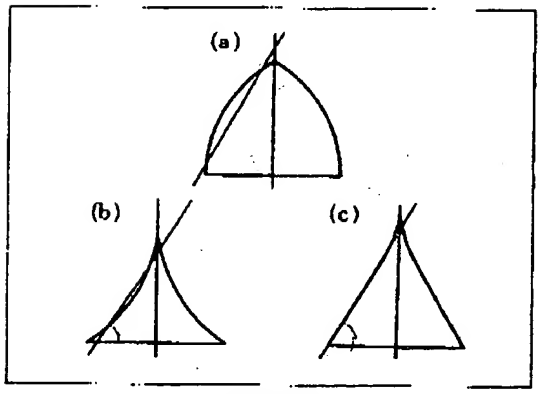
8. In case a conical shape is not completely formed repeat the above.
9. In the vent the vibration has to be stopped during the operation the arrow switch should be returned to "OFF" position. Pl ase do not re-set the rheostat while the timer switch is "ON".
10. After the cone has been built up, very carefully use the protractor on its stand (15) to measure the angle of the cone in relation to the edge of the platform. Please refer to Sketch 11.

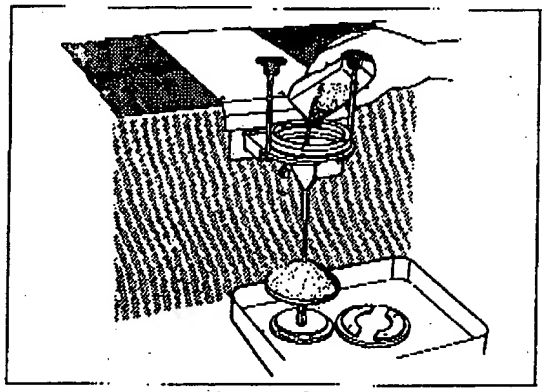


Sketch 11

11. Care, in the following should be exercised in testing.
    a. Vibrating plate is balanced with the funnel and other attachements. Do not operate the vibrating plate by itself. If the vibrating plate is actuated without the attachements, it will produce an impingement sound even as low as at 1mm amplitude.
    b. If the powder is fine and has a cohesive characteristic and the cone is irregular in shape measure several places and obtain an average figure or repeat the test three times and obtain an average.
    c. When a slope of the cone becomes a curved line then an average angle should be read. Please refer to Sketch 12.
    d. If the powder has a free-flowing characteristic or has coarse particles of larger than 24 mesh, the vibration is not necessary. So please remove screen (10) and charge the powder directly to the funnel by the scoop. (See Sketch 13)



Sketch 12



Sketch 13

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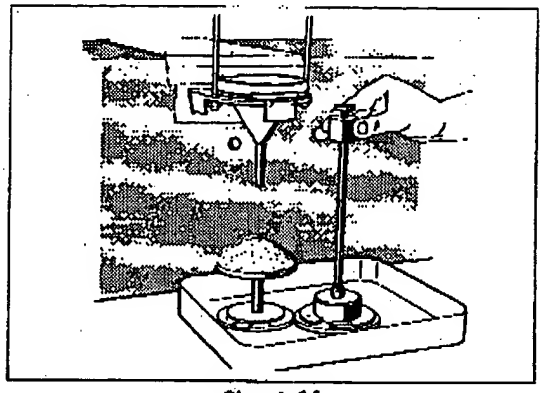
4-2 Angle of Fall:

1. After the determination of the Angle of Repose, place th shocker 17 on the shocker base (See Sketch 8)
2. Then raise the weight (carefully so that the cone will not be disturbed) on the slide and let it fall. Repeat this 3 times.



Sketch 14

3. Then measure the angle as before. Generally the Angle of Fall is smaller thant the Angle of Repose.
4. Meaning of the Angle of Fall:
   When the angle of Fall is small, the material has a free flowing characteristic. At the time when the angle falls, two phenomena are observed. In one case the particle falls along side of the cone's slope. In the other case the cone as a whole falls down. The latter phenomena is of special interest because it happens when the powder contains air within the powder layers. Such material often creates a flushing problem.

4-3 Angle of Difference:

The difference between the Angle of Repose and the Angle of Fall is defined as the Angle of Difference. The material has a characteristic of flushing when its Angle of Difference is great.

5. AERATED BULK DENSITY, PACKED BULK DENSITY AND COMPRESSIBILITY

5-1 Aerated Bulk Density:

1. Fix the various attachements in the following order.
   (i) Place the stationary chute (8) on the pins at the front of the tester. (Please refer to Sketch 15)
   (ii) The following parts should be mounted on the vibrating plate.

Vibrating chute	(9)
Spacer ring	(12)
Screen (24 mesh)	(10)
Screen cover	(11)
Screen holding bar	(13)

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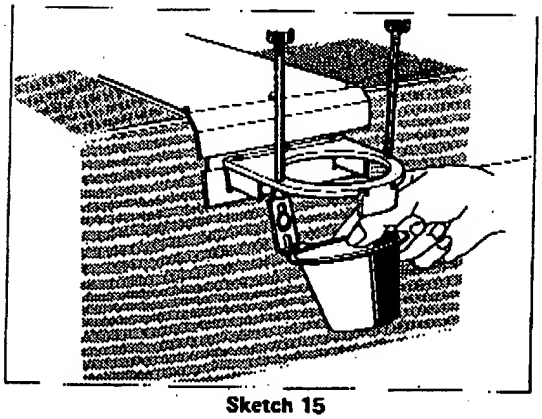
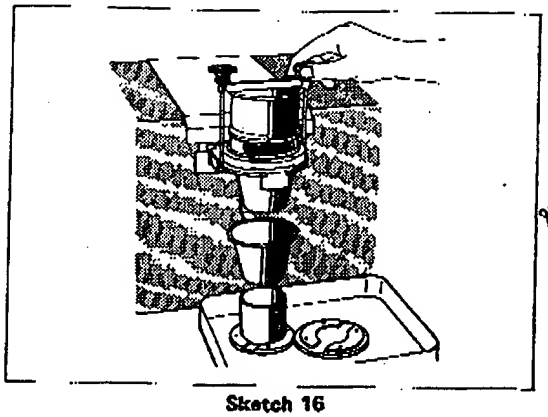
As has been done with for the Angle of R pose, fasten the above parts by knob-nuts. (Please refer to Sketch 16)

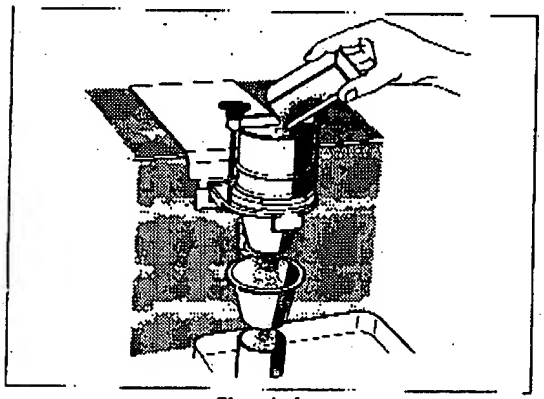


Sketch 15

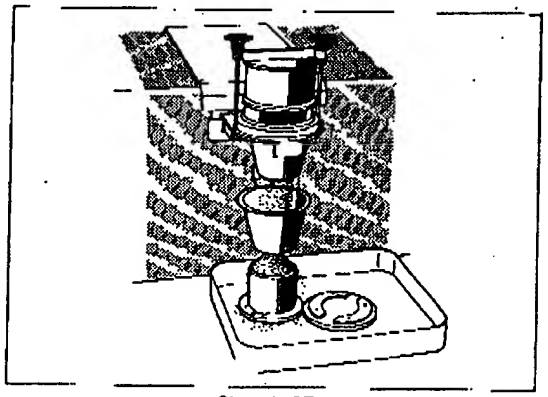


Sketch 16

2. Place the pan (14) directly under the stationary chute (8) and set in place bulk density measuring cup (6). The cup (6) should be inserted in the pit which is made in the pan (14). Make sure the center of the measuring cup (6) is in alignment with the center of the stationary chute (8). Please refer to Sketch 8.
3. Using scoop (2) gently put an adequate amount of the powder onto the screen (10).



Sketch 17



Sketch 18

4. Set the selector switch to "VIB"
5. The timer should be set for the maximum.
6. Ascertain the vibration amplitude rheostat is set at the "0" position.
7. Push the start button.
8. Increase the voltage on rheostat. The powder flow rate is controlled by the rheostat. As a standard, set the rheostat so that it will require approximately 20-30 seconds to heap the powder above the edge of cup (6). If the cup is filled too slowly or too quickly then the results may vary considerably.
9. When the powder heaps up in the cup (6) return the rheostat dial to "0" and then stop the vibration.
10. Using the scraper carefully remove the powder mound from the cup (6) by drawing scraper (3) across the top of the container. This should be done carefully in order to leave a flat surface of powder which is exactly level with the edge of the cup (6). When drawing the scraper across the cup be sure to have the scraper in an exactly

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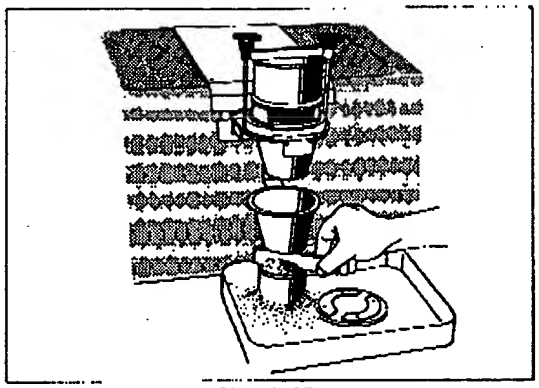
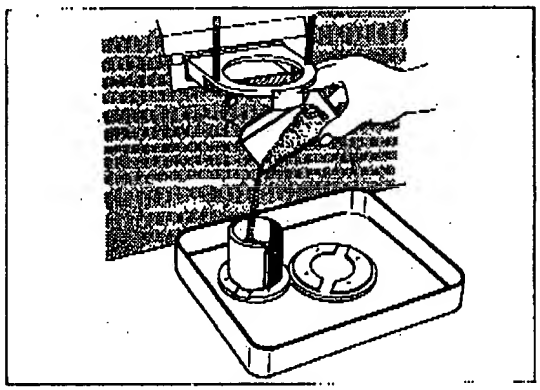
vertical position. When this has been done, weigh the container of powder carefully. The difference between the empty container weight and when full of powder will be the Bulk Density of the powder in grams per cc. (Note: as the container is xactly 100cc in volume the powder weight should be divid d by 100 to arrive at gms/cc)



Sketch 19

11. Measure aerated bulk density 3 — 5 times and obtain an average figure.
    Note: When the powder is free-flowing and of fairly coarse particle size, it will not be necessary to pass the vibrating screen. The powder can be gently poured into the cup (6) by the scoop.



Sketch 20

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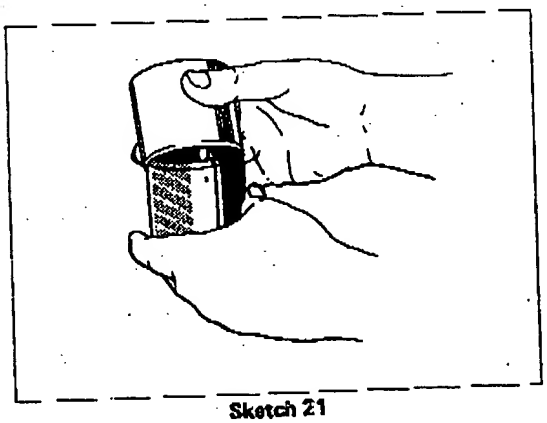
5-2 Packed Bulk Density.

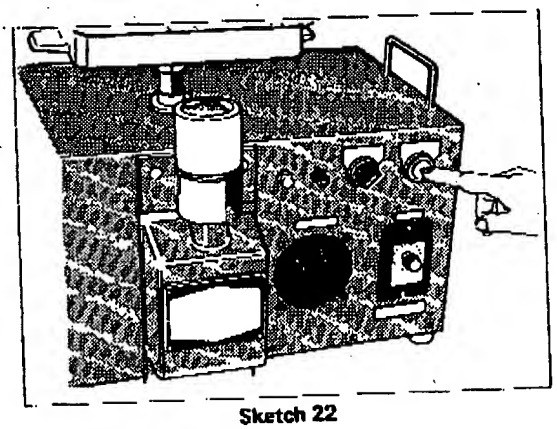
1. Place the previously fill d and leveled cup (6) in the automatic tapping device and place the cup extension pi ce (5) on top of the cup (6).



(12)

Sketch 21

2. Using the scoop (2) fill to the top with the same powder.
3. Turn the selector switch to the "TAP" position.
4. Set the timer switch at 180 seconds for 60 cycle. (For 50 cycle set the timer at 216 seconds)
5. Push the start button, which will activate the tapping device.



(13)

Sketch 22

6. During the tapping period it is necessary to observe the level of the powder and if necessary add powder to the container extension so that the powder will not pack below the rim of the container.
7. Tapping will be made 180 times and when the timer switch returns to the "0" position the tapping will cease automatically.
8. When the tapping is finished, remove the container and its extension (5). With the scraper remove the powder which is above the edge of the container. Use the same care when leveling off the container as in 5 – 1.

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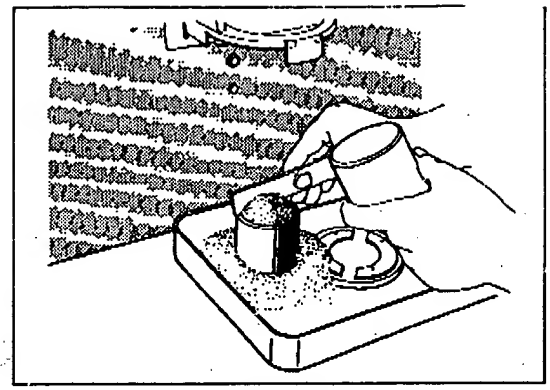

Sketch 23

9. Weigh the container and the powder and the difference in the weight of the empty container and when filled with powder will be the Packed Bulk Density (Divide the weight of powder by 100 to find the Packed Bulk Density in gms/cc)
   Note: If the tapping will have to be stopped during the tapping period, change the selector switch to "OFF" then the tapping will be stopped.

5-3 Compressibility:

Compressibility C is calculated by the following equation (1) where the Aerated Bulk Density is expressed as A and the Packed Density is expressed as P.

$$C = 100\,(P - A)/P \qquad (\%) \text{ --- } (1)$$

Meaning of Compressibility:

The compressibility is a very important factor in finding the flow characteristic of a powder. When the compressibility is above 20%, the powder is not free-flowing and has a tendency for creating bridges in the hopper. In particular when the compressibility is 40 — 50%, it is very hard to discharge the material from the hopper once the material has been stored in it.

6. MEASURING THE COHESION

1. Place following parts onto the vibrating plate:
   (i) Vibrating chute (9).
   (ii) Spacer ring (12).
   (iii) Screen (200 mesh)]
   (iv.) Screen (100 mesh) } These screens should be used with the powder having the average bulk density of 0.4-0.9 gm./cc and all passing 200 mesh screen. Average bulk density = $\frac{A+P}{2}$
   (v) Screen (60 mesh)]
   (vi) Holding bar (13)

2. Fasten above parts by knob-nuts.

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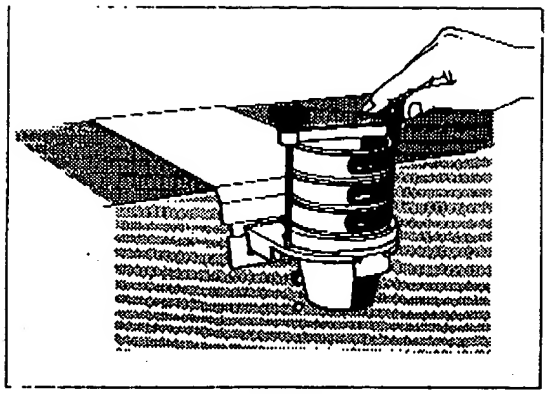
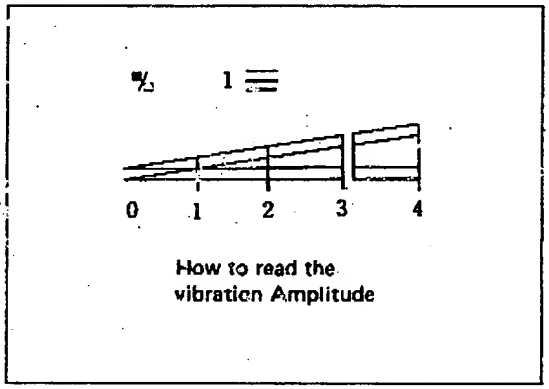


Sketch 24

3. Set the selector switch to "VIB".
4. Push the start button which will activate the vibration. Set the rheostat so that the vibration amplitude will be 1mm. The amplitude is read on the amplitude gauge. Please refer to the Sketch 25 which shows the amplitude of 1mm. The vibrating plate is supported by the cushion rubber so that in the very beginning vibration may be a bit unstable.



How to read the vibration Amplitude

Sketch 25

5. Wait until the timer comes to stop.
6. Set the timer according to the vibrating time calculated by the equation (2) and (3).

$$T = 20 + (1.6 - W)/0.016) \ldots\ldots \text{(Seconds)} \ldots (2)$$
$$W = (P - A)\, C/100 + A \ldots\ldots\ldots \text{(g/cc)} \ldots\ldots\ldots (3)$$

Where P. . . . . Packed Bulk Density
A . . . . Aerated Bulk Density
C . . . . Compressibility
W . . . . Dynamic Bulk Density

The relationship between T and W is shown in the Sketch 26. The graduation of the timer is by 5 seconds and it is not sufficiently accurate for this purpose. Thus the timer should be adjusted against a stopwatch so that the vibration will be given for the period calculated by the equation (2).

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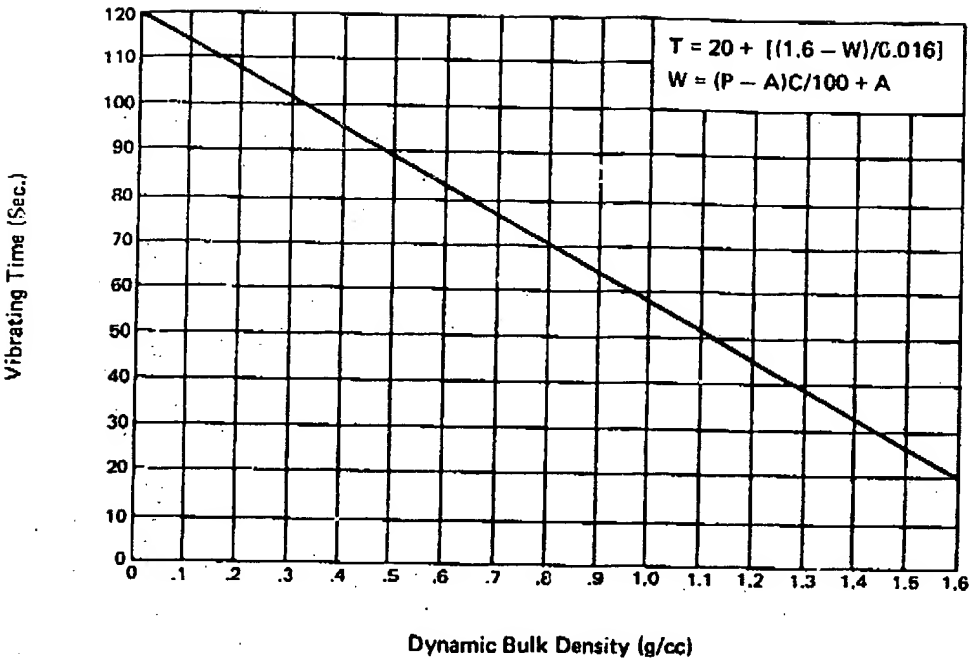
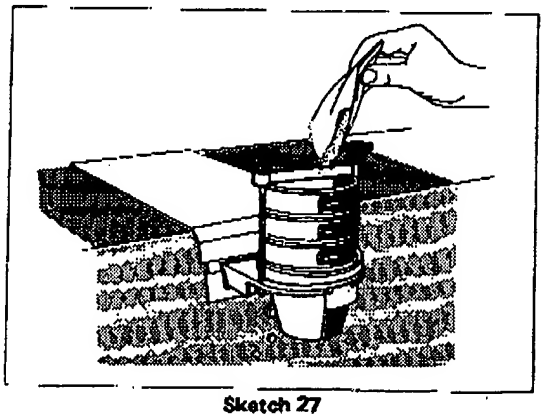


Sketch 26

Relationship between T and W
T = 20 sec. for the W = 1.6 gr/cc or more

7. While adjusting the timer, at the same time, the rheostat also should be re-adjusted to give an amplitude of 1mm.
8. Wait until the timer comes to a complete stop.
9. Weigh 2 gms. of powder and place it on the screen.



Sketch 27

10. Push the start button.
11. When vibrati n stops, loosen the knob nuts and remove the 3 scre ns and weigh the amount of powder retained on each screen. Brush off all material from the screen.

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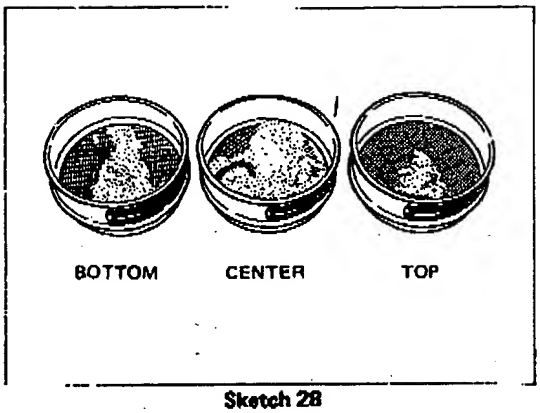

Sketch 28

12. Cohesion is calculated by following method.

$$\frac{\text{Material retained on the top screen}}{2g} \times 100 \quad \ldots \ (4)\ a$$

$$\frac{\text{Material retained on the center screen}}{2g} \times 100 \times \frac{3}{5} \quad \ldots \ (4)\ b$$

$$\frac{\text{Material retained on the bottom screen}}{2g} \times 100 \times \frac{1}{5} \quad \ldots \ (4)\ c$$

Sum of above three figure (4) a, (4) b and (4) c will give the Cohesion (%).

Meaning of Cohesion:

The powder has lesser flowability when it has a higher Cohesion %. With powder which has higher Cohesion, care is needed in designing feeder, hopper and other handling equipment.

Note: 1. With comparatively litht material (i.e. Average bulk density = 0.16 – 0.4g/cc) use coarse screen (i.e. 40, 60, 100 mesh). For heavier material (i.e. average bulk density = 0.9 – 1.5g/cc) use fine screens (i.e. 100, 200, 350 mesh). In any case the material should be fine enough to pass the bottom screen.

2. If the material particles have a tendency to be attracted to each other by electrostatic force or form balls on vibration, accurate figures cannot be obtained.

3. Measuring can be done using either 50 or 60 cycle current but use the same cycle for comparison purposes.

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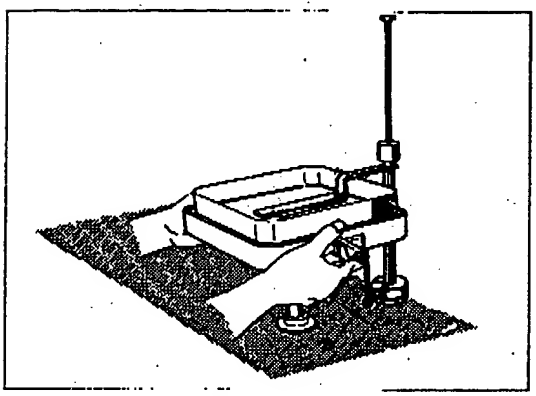
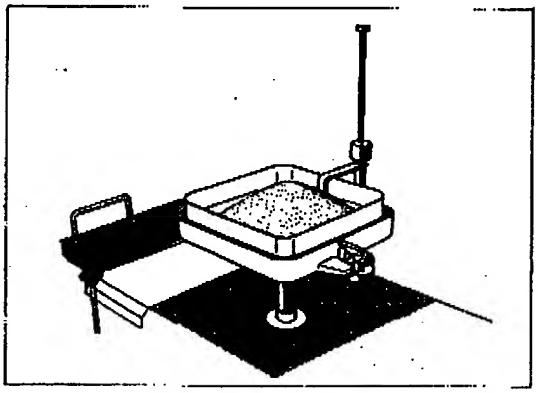
7. MEASURING ANGLE OF SPATURA

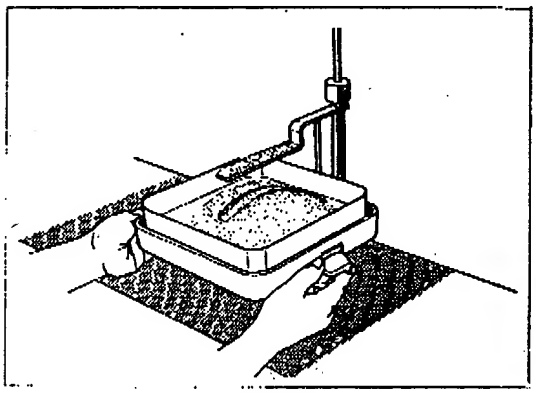
1. Raise th pan on top of the Powder Tester until the pan touches th spatula. Use both hands to lift the pan. (See Sketch 29)
2. Fill the pan with the powder s that the spatula is completely covered with several centimeters of powder. (See Sketch 30)
3. Carefully lower the pan which will expose the spatula with a considerable quantity of powder on it. (See Sketch 31).
4. Carefully measure the Angle of the Powder on the spatula and if the appearance of the powder is irregular then measure the angle at several different points and obtain the average. (See Sketch 32)



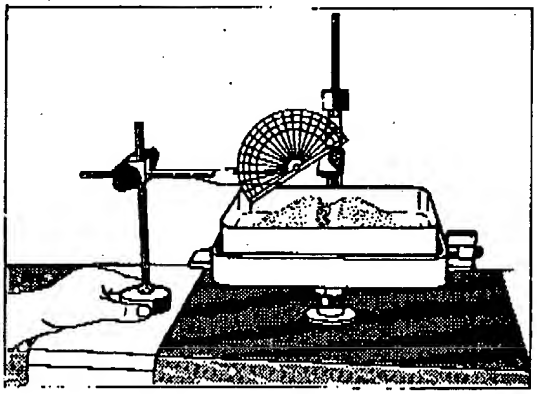
Sketch 29



Sketch 30



Sketch 31



Sketch 32

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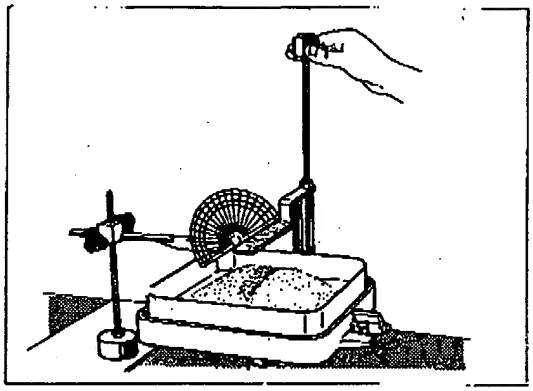
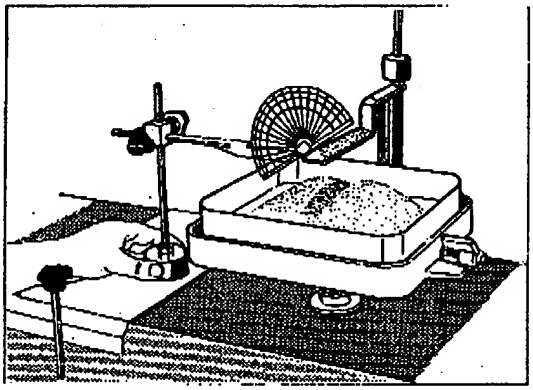
5. Raise the weight of the slide hammer and let it fall once. (See Sketch 33)



Sketch 33

6. Then measure the angle after dropping the slide hammer.



Sketch 34

7. If necessary measure the angle at several points and obtain the average. Add 2 average angles (i.e. before and after dropping the hammer) and divide by 2 which will give the Angle of Spatula.

Meaning of Angle of Spatula:

The higher the Angle of Spatula, the worse the flowability of powder is. The Angle of Spatula is always greater when the Angle of Repose.

Note: When heaping up the powder on the spatula, use approximately the same amount always, otherwise the figure will fluctuate and cannot be compared from one to the other.

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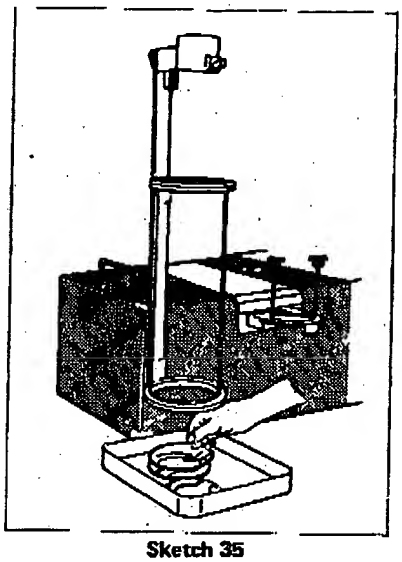
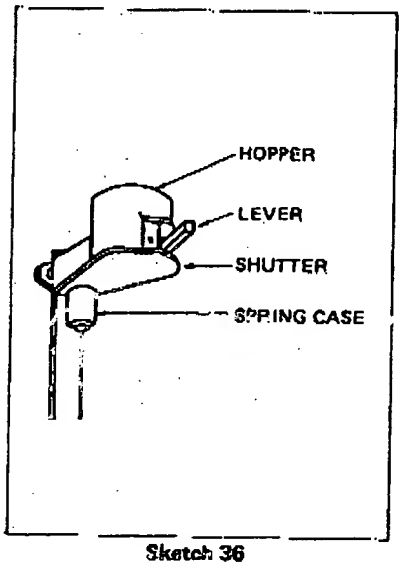
8. DISPERSIBILITY

1. As explained in the preparation, set the Dispersibility Measuring unit in place.
2. Place the par (14) under the cylindrical glass tube. Put the spacer ring (12) into the pit of the pan (14) and then place the watch glass in position.
3. Center the watch glass (4) carefully under the glass tube.



Sketch 35

4. Carefully wiegh 10 grams of powder and place it in the container which is above the round glass tube. (Please refer to Sketch 36)



Sketch 36

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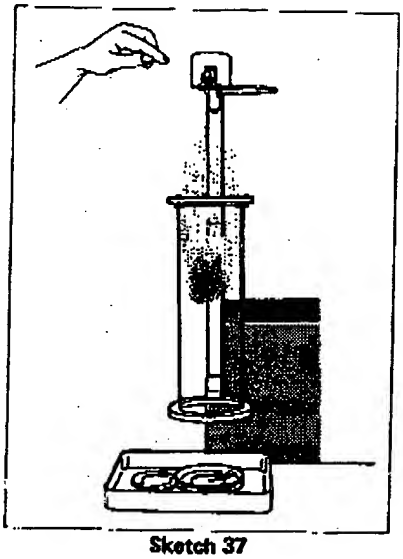
5. Push lever down which will cause the damper at the bottom of the container to spring to one side allowing the powder to fall through the glass tube and onto the watch glass.



Sketch 37

6. Weigh the watch glass and the powder.

   Note: Weigh the watch glass before the start of this test.

7. Dispersibility is obtained by the following equation.
   (10 – Weight of powder on watch glass) x 10 = % of Dispersibility ..... (5)

   Meaning of Dispersibility:

   Dispersibility indicates the fugacity, dusting and flushing characteristics of powder. If the dispersibility index is higher than 50%, the powder will have a high flushing characteristic.

   Note: When the damper does not spring well, pull down the spring case which is placed underneath the damper, and re-set the spring in the following manner: Detach the hook and wind the spring by turning it in an anticlockwise direction. There are four hook holes positioned every 90 degrees, so replace the hook in the proper hole.

9. NUMERICAL EVALUATION SYSTEM OF FLOWABILITY AND FLOODABILITY:

All of the figures measured in the foregoing have a meaning in themselves as the physical properties of the powder. Mr. Carr has tried to evaluate powder's flowability and floodability in a numerical manner with a combination of these various physical characteristics. For this purpose Mr. Carr has published tables for the conversion of the measured figures into a common index. To use the figures obtained with the Powder Tester as if they are in direct relationship with Mr. Carr's tables may not be appropriate. However, the Powder Tester will be a useful and practical aid for the comparison of the properties of the same powders.

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9-1 Evaluation System of Flowability

The four characteristics mentioned below are utilized for numerical evaluation of Flowability

1. Angle of Repose
2. Compressibility
3. Angle of Spatula
4. Cohesion or Uniformity

Uniformity is the index to indicate the range of the particle size distribution. This uniformity is obtained by sieving the powder and is calculated as follows:

$$\frac{\text{Particle size of which 60\% of the powder passes}}{\text{Particle size of which 10\% of the powder passes}} = \text{Uniformity Index.}$$

As narrow as the particle size distribution is, the index becomes close to 1. This uniformity index is applied when the powder is rather coarse and not so cohesive. For the fine and cohesive powder, "Cohesion" degree is used.

After measuring various properties, the Table 1 is used for converting the measured figures into the index numbers. The total of these index numbers indicate the Flowability Index. The three columns in the left of the table will give an idea about the necessity for bridge breading measures.

9-2 Floodability Evaluation:

For the numerical evaluation of the Floodability the following four properties are applied:

1. Flowability (This is obtained as the index with the method mentioned above. With the material possible to flush, the higher the flowability is, the higher is the degree of floodability.)
2. Angle of Fall
3. Angle of Difference
4. Dispersibility.

With the Table 2 the measured properties are converted into the index numbers. The total of these index numbers are the Floodability Index. From the three columns on the left the powder's Floodability can be judged and also whether sealing is necessary or not.

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Degree of Flowability	Flowability Index	Necessity of Bridge-breaking measures	Angle of Repose		Compresibility		Angle of Spatula		Uniformity*		Cohesion**	
			Degree	Index	%	Index	Degree	Index	No.	Index	%	Index
Very Good	90 – 100	Not required	<25 26 – 29 30	25 24 22.5	<5 6 – 9 10	25 23 22.5	<25 26 – 30 31	25 24 22.5	1 2 – 4 5	25 23 22.5		
Fairly Good	80 – 89	Not required	31 32 – 34 35	22 21 20	11 12 – 14 15	22 21 20	32 33 – 37 38	22 21 20	6 7 8	22 21 20		
Good	70 – 79	Sometimes Vibrator is required	36 37 – 39 40	19.5 18 17.5	16 17 – 19 20	19.5 18 17.5	39 40 – 44 45	19.5 18 17.5	9 10 – 11 12	19 18 17.5		
Normal	60 – 69	Bridging will take place at the marginal point	41 42 – 44 45	17 16 15	21 22 – 24 25	17 16 15	46 47 – 59 60	17 16 15	13 14 – 16 17	17 16 15	<6	15
Not Good	40 – 59	Required	46 47 – 54 55	14.5 12 10	26 27 – 30 31	14.5 12 10	61 62 – 74 75	14.5 12 10	18 19 – 21 22	14.5 12 10	6 – 9 10 – 29 30	14.5 12 10
Bad	20 – 39	Powerful measures should be provided	56 57 – 64 65	9.5 7 5	32 33 – 36 37	9.5 7 5	76 77 – 89 90	9.5 7 5	23 24 – 26 27	9.5 7 5	31 32 – 54 55	9.5 7 5
Very Bad	0 – 19	Special apparatus and techniques are required.	66 67 – 89 90	45 2 0	38 39 – 45 >45	4.5 2 0	91 92 – 99 >99	4.5 2 0	28 29 – 35 >35	4.5 2 0	56 57 – 79 >79	4.5 2 0

* Use these figure for granules or granular powder with which the uniformity can be measured.
** Apply these figures for fine and cohesive powders with which the cohesion can be measured.

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Degree of Floodability	Floodability Index	Measures for Flushing Prevention	Flowability		Angle of Fall		Angle of Difference		Dispersibility	
			Index from Table 1	Index	Degree	Index	Degree	Index	%	Index
Very high	80 – 100	Rotary seal must be used	>60	25	<10	25	>30	25	>50	25
			59 – 56	24	11 – 19	24	29 – 28	24	49 – 44	24
			55	22.5	20	22.5	27	22.5	43	22.5
			54	22	21	22	26	22	42	22
			53 – 50	21	22 – 24	21	25	21	41 – 36	21
			49	20	25	20	24	20	35	20
Fairly High	60 – 79	Rotary seal is required	48	19.5	26	19.5	23	19.5	34	19.5
			47 – 45	18	27 – 29	18	22 – 20	18	33 – 29	18
			44	17.5	30	17.5	19	17.5	28	17.5
			43	17	31	17	18	17	27	17
			42 – 40	16	32 – 39	16	17 – 16	16	26 – 21	16
			39	15	40	15	15	15	20	15
Tends to flush	40 – 59	Sometimes Rotary seal is required	38	14.5	41	14.5	14	14.5	19	14.5
			37 – 34	12	42 – 49	12	13 – 11	12	18 – 11	12
			33	10	50	10	10	10	10	10
May flush	25 – 39	Rotary seal is necessary depending on flow speed and feeding conditions	32	9.5	51	9.5	9	9.5	9	9.5
			31 – 29	8	52 – 56	8	8	8	8	8
			28	6.25	57	6.25	7	6.25	7	6.25
Won't flush	0 – 24	Not required	27	6	58	6	6	6	6	6
			26 – 23	3	59 – 64	3	5 – 1	3	5 – 1	3
			23	0	>64	0	0	0	0	0

Remarks: The above tables are reprinted from "Chemical Engineering" pages 166 and 167 of January 18, 1965, with approval of Mr. Ralph Carr, Jr., and the copyright owner, McGraw-Hill Incorporated, New York, N.Y., 10036, U.S.A.

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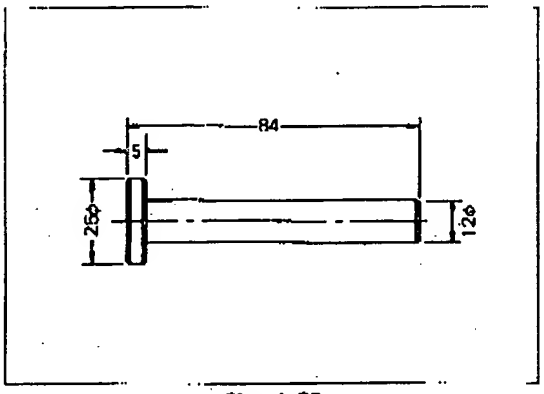
10. MAINTENANCE

1. Occasionally, remove tapping pin and clean its sliding surface with a dry cloth. If the powder sticks to the pin, then the pin will be prevented from smooth operation. When the contacting surface of the cam wears out then it should be replaced with a new one. Tapping pin is made of abrasion resisting nylon.



Sketch 38

2. Pan holder for measuring angle of spatula can be removed by pulling it out of the main body. Occasionally clean the sliding surface of the pan holder.
3. For any problem or for need of replacement parts, please contact Distributor in your area or Hosokawa International Inc., No. 10, 2-Chome, Minami-Kyutaro Machi, Higashi-Ku, Osaka, 541, Japan.

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